



**Northeast Fisheries Science Center Reference Document 17-11**

<https://doi.org/10.7289/V5/RD-NEFSC-17-11>

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**U.S. DEPARTMENT OF COMMERCE**

National Oceanic and Atmospheric Administration

National Marine Fisheries Service

Northeast Fisheries Science Center

Woods Hole, Massachusetts

June 2017

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**Information Quality Act Compliance:** In accordance with section 515 of Public Law 106-554, the Northeast Fisheries Science Center completed both technical and policy reviews for this report. These predissemination reviews are on file at the NEFSC Editorial Office.

This document may be cited as:

Gatzke J, Khan C, Henry A, Crowe L, Duley P, Cole T. 2017. North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2015 Results Summary. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 17-11; 15 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/>  
<https://doi.org/10.7289/V5/RD-NEFSC-17-11>

## **NORTH ATLANTIC RIGHT WHALE SIGHTING SURVEY (NARWSS)**

The North Atlantic Right Whale Sighting Survey (NARWSS) is a NOAA Fisheries program which locates and records the seasonal distribution of North Atlantic right whales (*Eubalaena glacialis*) off the northeastern coast of the United States. Annual reports from past surveys are available for the NARWSS program dating back to 2002 (Cole et al 2007a, 2007b; Gatzke et al 2013; Khan et al 2016, 2014, 2012, 2011, 2010, 2009; Niemeyer et al 2007a, 2007b, 2008; Rone et al 2007a, 2007b). NARWSS flights conducted in 2015 followed systematic tracklines with randomized starting locations within 14 primary survey blocks: Atlantis Canyon, Cashes Ledge, Mount Desert Rock and Grand Manan, Franklin Basin, Georges Basin, Georges Shoal, Great South Channel, Howell Swell, Jeffreys Ledge, Jordan Basin, Lindenkohl Basin, Rhode Island Sound, Martha's Vineyard and Nantucket, and Stellwagen Bank (Figure 1). During 2015, NARWSS flew 338.3 hours over 79 surveys (Table 1), including 1 directed survey over Great South Channel and 1 sawtooth flight over Atlantis Canyon. NARWSS detected 127 right whales (including possible duplicate sightings of the same individuals), with 114 right whales sighted within survey blocks and 13 right whales sighted during transits to or from survey areas. Table 1 summarizes survey effort and right whale sightings by month. Figure 2(a-d) displays the locations of right whales and survey effort by season. In 2015, NARWSS did not conduct aerial surveys during February, September, or October. In late July - August, surveys were conducted in Canadian waters and are detailed in a separate report (Cole et al. 2016). Table 2 and Figure 3 provide a comparison of NARWSS flights, flight hours, and right whale sightings from 2002 through 2015. Table 3 summarizes internal and external requests for NARWSS survey data.

## **RIGHT WHALE SIGHTING ADVISORY SYSTEM (RWSAS)**

In 2009, the Right Whale Sighting Advisory System (RWSAS) was reengineered to support new regulations to reduce the probability of lethal injury to right whales from collisions with ships (50 CFR Part 224). The regulations established speed restrictions of 10 knots or less for all vessels of length 65 feet (19.8 m) or greater within Seasonal Management Areas (SMAs). The SMAs encompass areas of relatively high risk for whale-vessel collision along the US Atlantic seaboard where right whale sightings predictably and consistently occur each year<sup>1</sup>. If an aggregation of 3 or more right whales is sighted outside of a SMA, a Dynamic Management Area (DMA) is established for 15 days (Clapham and Pace 2001), and mariners are requested to either avoid the area or travel through it at 10 knots or less. Unlike SMAs, compliance is voluntary for DMAs. The size of the DMA depends on the number of right whales sighted in the area. Mariners are notified of DMAs via email, an interactive Google Map website<sup>2</sup>, the Whale Alert iPad/iPhone app<sup>3</sup>, a Broadcast Notice to Mariners (BNM), and the Mandatory Ship Reporting system (MSR). In 2015, 11 DMAs (including extensions) were triggered by validated right whale sighting reports, 2 of which were triggered by NARWSS sightings (Table 4). The RWSAS collected sighting reports from aerial research surveys, shipboard research surveys, commercial whale watch vessels, the US Coast Guard, and other sources (commercial ships, fishing vessels, and the general public). The most common source of reports in 2015 was aerial surveys (546 reports - 62%; see Figure 4(a-c), Figure 5, and Table 5). Most reports in Canada were from the dedicated right whale aerial surveys reported in Cole et al 2016 (also shown in Table 5 and

<sup>1</sup> <http://www.nmfs.noaa.gov/pr/shipstrike/>

<sup>2</sup> <http://www.nefsc.noaa.gov/psb/surveys/>

<sup>3</sup> <http://www.whalealert.org/>

Figure 4a). Most sightings were in the Northeast (New York to Maine), where the number of reports per month ranged from 1 in December to 341 in April (Table 5 and Figure 4b). Most reports in the Mid-Atlantic (New Jersey through Virginia) were from other sources (commercial ships and opportunistic sightings) (Table 5 and Figure 4c). Logging acoustic detections into the RWSAS was discontinued in 2009 in favor of publicly available automated acoustic detection websites maintained by the Bioacoustics Research Program at the Cornell Lab of Ornithology<sup>4</sup>, which provide the information in near real-time.

## **ACKNOWLEDGEMENTS**

We would like to extend our gratitude to NARWSS aerial observers (Corey Accardo, Karen Vale, and Marjorie Foster), NOAA Aircraft Operations Center, the NOAA Twin Otter pilots, and the United States Coast Guard Air Station Cape Cod.

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<sup>4</sup> <http://www.listenforwhales.org/>

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**Table 1. Summary of North Atlantic Right Whale Sighting Survey (NARWSS) flights conducted in 2015 by month including the survey block, number of flights, flight hours, and right whale (*Eubalaena glacialis*) sightings.**

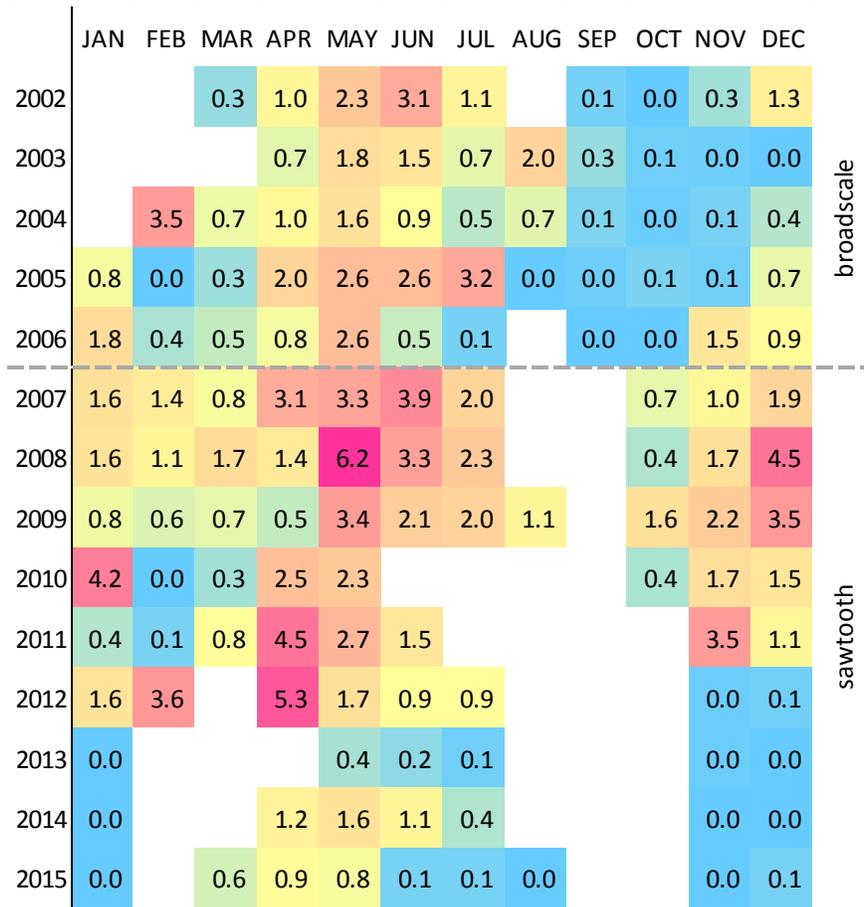
**Total Number of Flights in each Survey Block**

Month	Total Number of Flights in each Survey Block														Number of Flights	Number of Flight Hours <sup>1</sup>	Number of Right Whales <sup>2</sup>
	Atlantis Canyon	Cashes Ledge	Franklin Basin	Georges Basin	Georges Shoal	Great South Channel	Howell Swell	Jeffreys Ledge	Jordan Basin	Linden Kohl Basin	Martha's Vineyard + Nantucket	Mt. Desert Rock + Grand Manan	Rhode Island Sound	Stellwagen Bank			
January						1			1						2	9.9	0
February															0	0	0
March		1				2						2	1		6	25.8	15
April			1	1		6		2			1	2	1		14	67.3	61
May		2	1			5	1		1		1		1		12	52.6	40
June	1	1	1	1	1	3	3	2	1	2	1	1	1	1	20	80.9	5
July				1		2							1	1	5	19.5	2
August											1		1		2	7.2	0
September															0	0	0
October															0	0	0
November						3		1	1		1		3	2	11	42.8	2
December		2					1	1			1	1	1		7	32.5	2
<b>Number of Flights</b>	<b>1</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>22</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>2</b>	<b>6</b>	<b>3</b>	<b>11</b>	<b>7</b>	<b>79</b>		
<b>Number of Flight Hours<sup>1</sup></b>	<b>4.6</b>	<b>31</b>	<b>11.7</b>	<b>14.7</b>	<b>3.5</b>	<b>89.2</b>	<b>20</b>	<b>30</b>	<b>18</b>	<b>6</b>	<b>28</b>	<b>17</b>	<b>34.8</b>	<b>35</b>		<b>338.3</b>	
<b>Number of Right Whales<sup>2</sup></b>	<b>0</b>	<b>10</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>53</b>	<b>8</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>0</b>	<b>14</b>	<b>22</b>			<b>127</b>

<sup>1</sup> Includes transit, survey, and circling to photograph whales; does not include flights that were aborted due to bad weather.

<sup>2</sup> Includes duplicate individuals, but not whales seen on transit.

**Table 2. Comparison of the total number of right whale (*Eubalaena glacialis*) sightings per flight hour by month and year from the North Atlantic Right Whale Sighting Survey (NARWSS) flights. Numbers indicate the number of right whales seen per flight hour in a given month and year with heat map ranging from blue (no right whale sightings) to hot pink (maximum 6.2 right whales per flight hour).**



**Table 3. Summary of data requests made in 2015 for North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS).**

<b>Organization</b>	<b>Database</b>	<b>Data Request Description</b>
Granite St. Whale Watch / Blue Ocean Society	NARWSS	Jeffrey's Ledge sightings
NOAA	NARWSS	NEFSC aerial data within 5 nm of SBNMS
New England Aquarium	shapefiles	NEAQ boundaries in photo ID data
Center for Coastal Studies	Images	2014 fin whale images
Duke University	NARWSS/RWSAS	NARWSS 2013, 2014; SAS 2014
Marine Mammal Commission	NARWSS	Images
NOAA GARFO	RWSAS	Map - sightings in Cape Cod Bay
University of Massachusetts Dartmouth	NARWSS	Odontocete aerial survey data
NOAA NEFSC PSB	NARWSS	5/2015 NARWSS sei whale sightings
NOAA NEFSC PSB	NARWSS	2014 NARWSS sei whale sightings
Shark Identification Network	NARWSS	All NARWSS shark sightings
NOAA NEFSC PSB	NARWSS	Aerial survey data 2012 - 2013
NOAA GARFO	Canada	2015 Canadian data -Leatherback turtles
Inha University, South Korea	Photo/Kaggle	Right Whale dataset
Mississippi State University	Photo/Kaggle	Right whale aerial photographs

**Table 4. Summary of Dynamic Management Areas (DMA) in 2015, triggered by a confirmed report to the Right Whale Sighting Advisory System (RWSAS) of 3 or more right whales (*Eubalaena glacialis*) in close proximity to each other outside of any active Seasonal Management Areas (SMA).**

DMA Name	# Whales	North	South	West	East	Start Date	End Date
40 nm SE Delaware	12	38.75	37.98	-74.88	-74.00	17-Jan-15	1-Feb-15
10 nm SW Nantucket	10	41.48	40.72	-70.85	-69.87	24-Feb-15	10-Mar-15
13 nm S Martha's Vineyard	6	41.40	40.68	-71.22	-70.18	13-Mar-15	28-Apr-15
65 nm E New York NY	4	41.13	40.45	-73.05	-72.13	28-Mar-15	12-Apr-15
35 nm S of Providence	4	41.62	40.93	-71.65	-70.73	1-Apr-15	16-Apr-15
11 nm SW Nantucket	5	41.43	40.73	-70.78	-69.85	16-Apr-15	1-May-15
120 nm NE Boston	6	42.88	42.15	-68.92	-67.93	5-May-15	20-May-15
85 nm ENE Boston	3	43.05	42.40	-69.57	-68.67	14-May-15	29-May-15
44 nm SE Cape Cod	10	41.75	41.02	-68.65	-69.57	20-May-15	4-Jun-15
35 nm ESE Nantucket	3	41.42	40.77	-69.68	-68.80	28-May-15	13-Jun-15
13 nm ESE Boston	3	42.63	41.97	-71.25	-70.35	1-Aug-15	17-Aug-15

**Table 5. The total number of right whale (*Eubalaena glacialis*) sighting reports to the Right Whale Sighting Advisory System (RWSAS) in 2015 by reporting source and month within Canadian waters, the Northeast region (New York to Maine), and the Mid-Atlantic region (New Jersey through Virginia).**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
Canada	Aerial Survey							19					19	33
	Shipboard Survey							4	8				12	21
	Whale Watch					5	5	1	2				13	23
	Coast Guard												0	
	Other					1	3	5	4				13	23
	Canada Totals					1	8	10	28	10				57
Northeast	Aerial Survey	5	34	18	254	178	4	1			2	1	497	69
	Shipboard Survey	1	6	6	29	21							63	9
	Whale watch			1	25	16	3	7	1	4			57	8
	Coast Guard		1	1	5		2			1			10	1
	Other	2	1	2	28	47	2	2	1	4	1	3	93	13
	Northeast Totals	8	42	28	341	262	11	10	2	8	2	5	1	720
Mid-Atlantic	Aerial Survey		6	15	9	1							31	58
	Shipboard Survey					5							5	9
	Whale watch							1					1	2
	Coast Guard				1	1							2	4
	Other	1		8	2	1		2					14	26
	Mid-Atlantic Totals	1	6	23	12	8		2	1					53

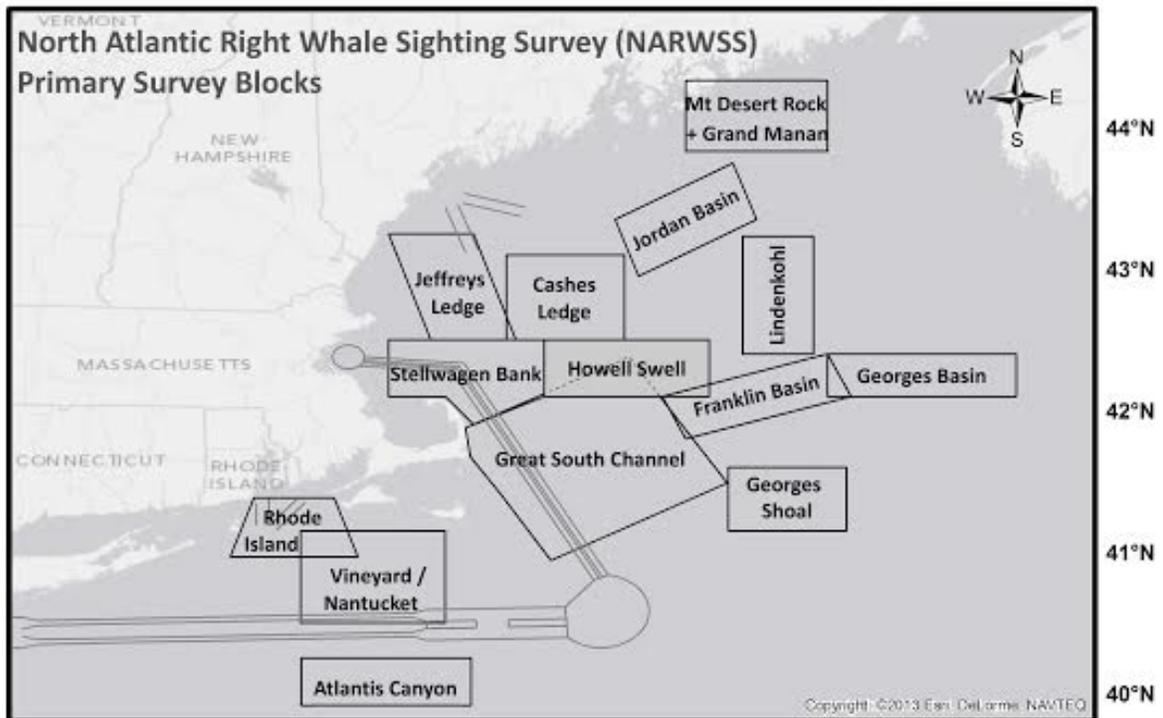


Figure 1. North Atlantic Right Whale Sighting Survey (NARWSS) blocks. Shipping lanes are denoted in gray.

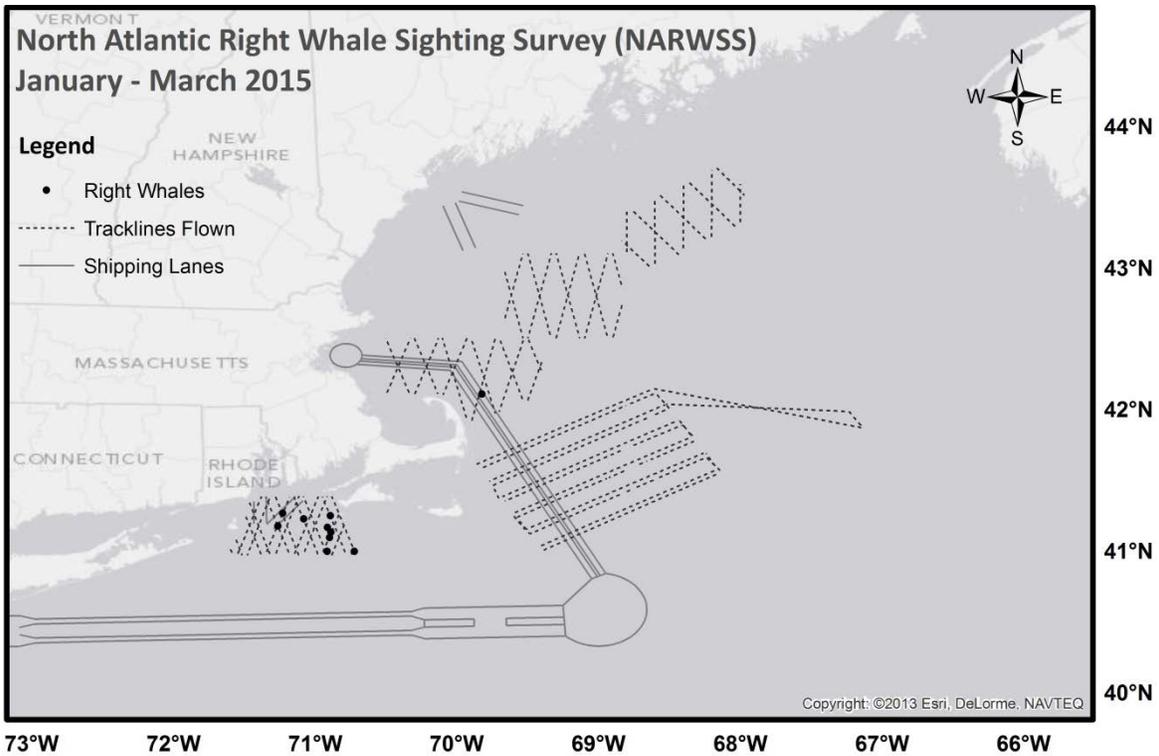


Figure 2a. North Atlantic Right Whale Sighting Survey (NARWSS) tracklines flown and right whale (*Eubalaena glacialis*) sightings January through March 2015. No surveys were flown in February 2015.

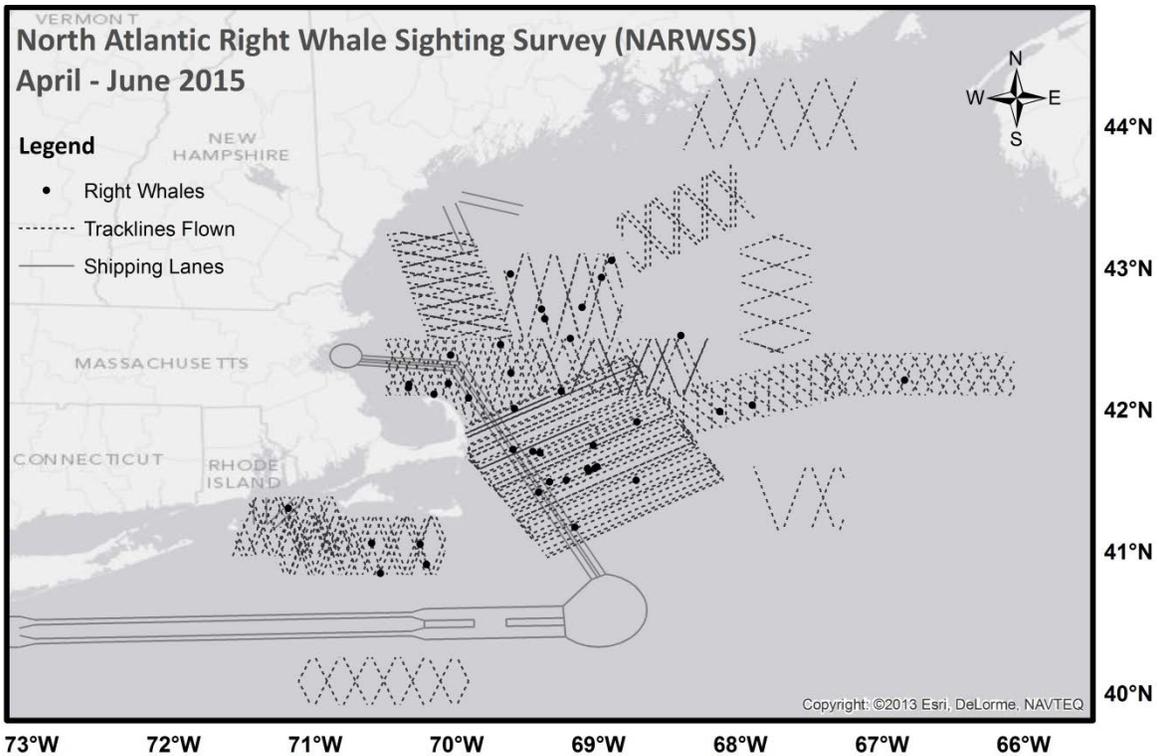


Figure 2b. North Atlantic Right Whale Sighting Survey (NARWSS) tracklines flown and right whale (*Eubalaena glacialis*) sightings from April through June 2015.

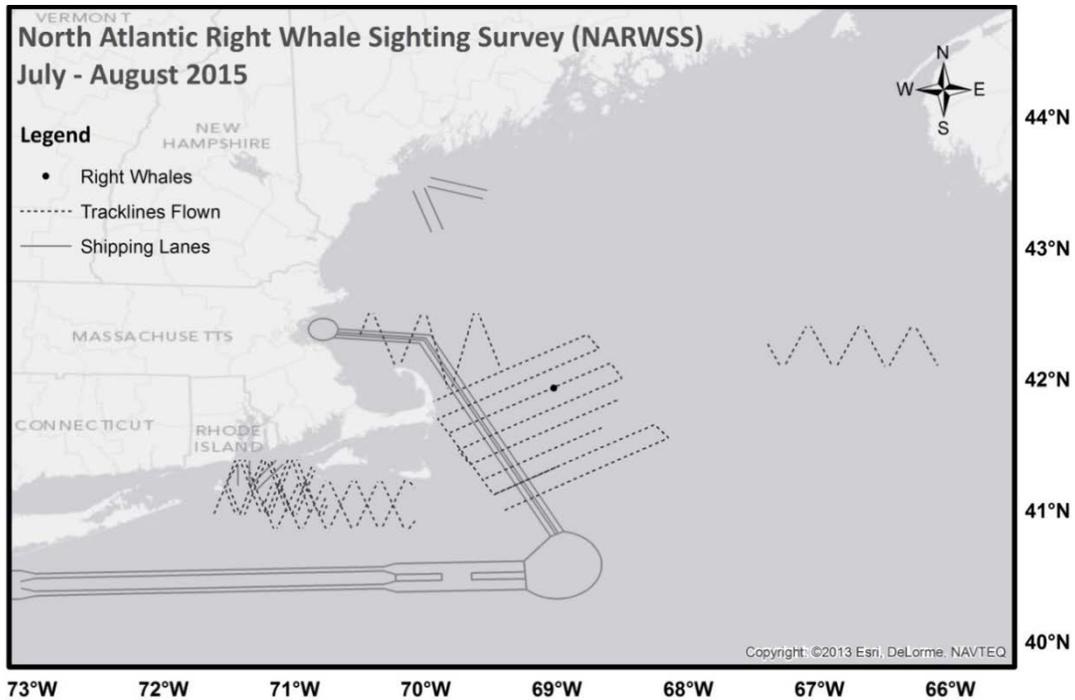


Figure 2c. North Atlantic Right Whale Sighting Survey (NARWSS) tracklines flown and right whale (*Eubalaena glacialis*) sightings from July through August 2015. In late July - August, surveys were conducted in Canadian waters and are detailed in a separate report (Cole et al 2016).

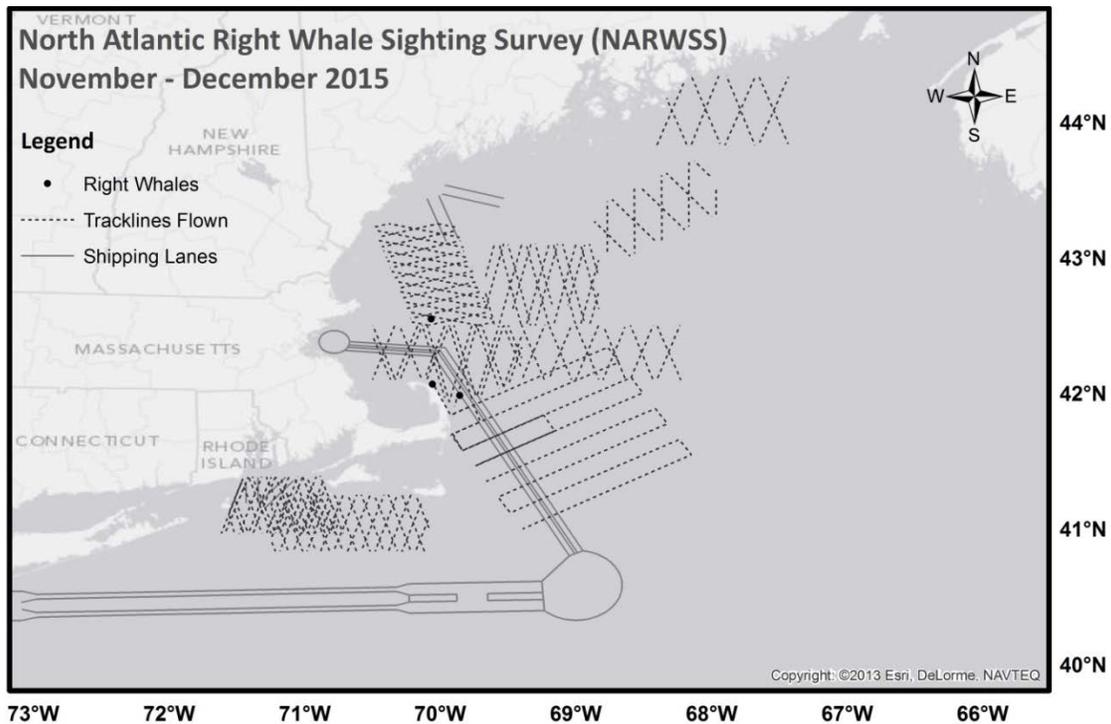
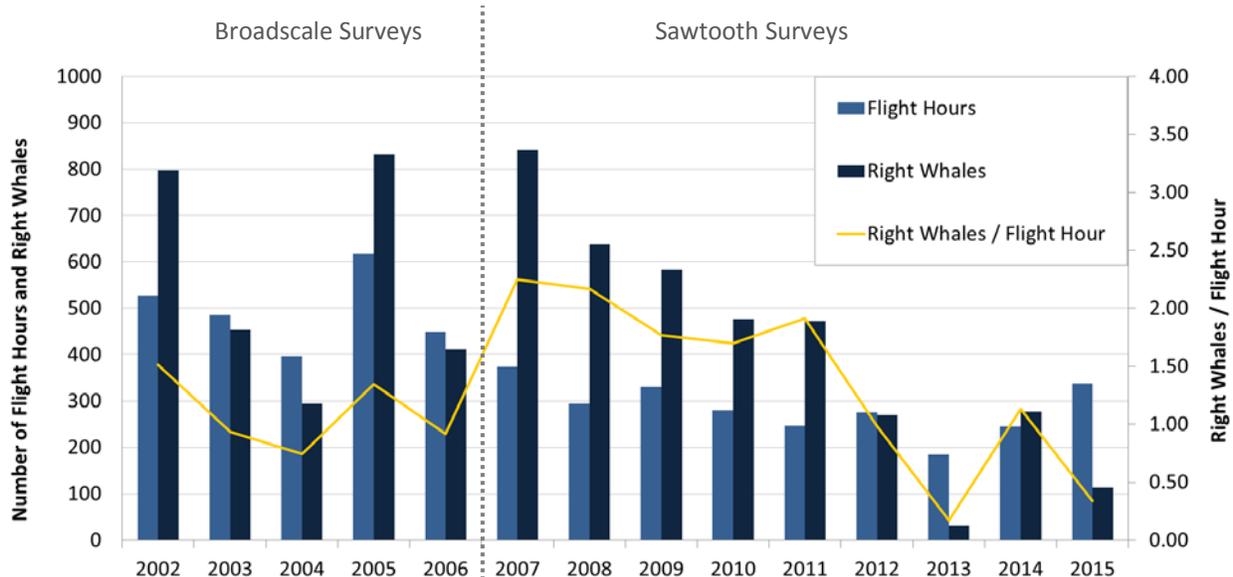
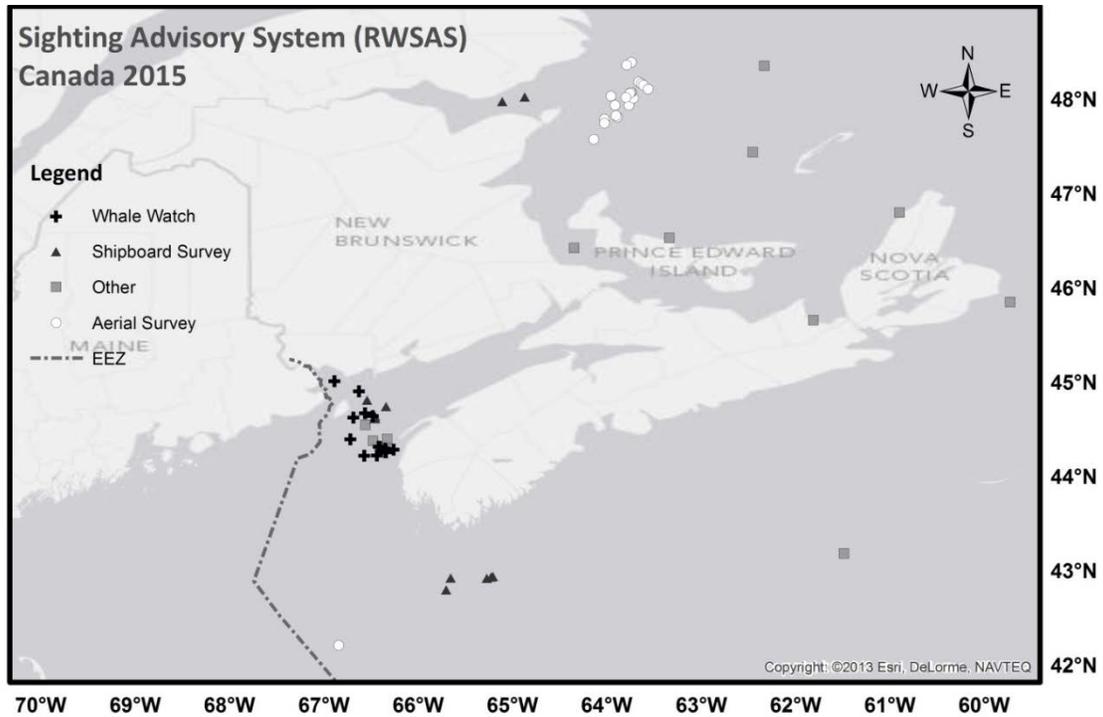


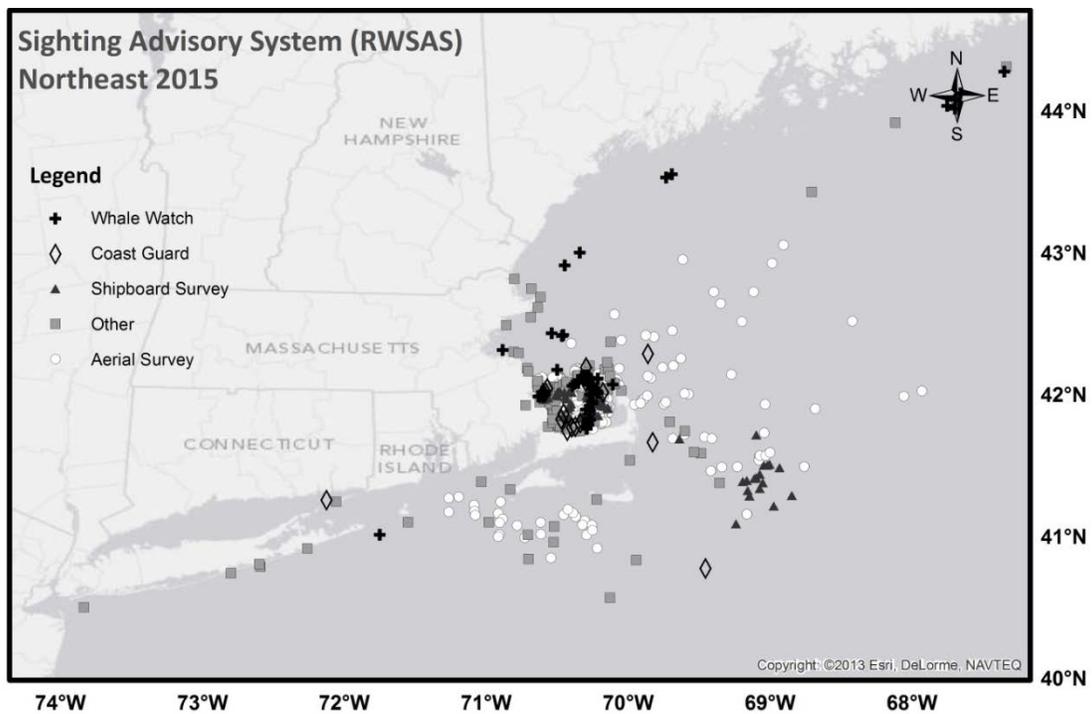
Figure 2d. North Atlantic Right Whale Sighting Survey (NARWSS) tracklines flown and right whale (*Eubalaena glacialis*) sightings from November and December of 2015. No surveys were flown in September or October of 2015.



**Figure 3. Comparison of North Atlantic Right Whale Sighting Survey (NARWSS) hours flown and right whale (*Eubalaena glacialis*) sightings from 2002 through 2015 with the number of right whales seen per flight hour overlaid. The number of flights includes randomized systematic, directed, and exploratory surveys. The number of flight hours includes time on transit, on survey, and circling to photograph whales. The number of whales includes duplicate individuals but not whales seen on transit. The number of right whales sighted per flight hour increased in 2007 when the sawtooth survey design replaced broadscale systematic surveys that covered the entire Gulf of Maine (Cole et al 2007). From 2002 - 2005 there were periods when 2 survey aircraft were used concurrently.**



**Figure 4a.** Locations of all right whales (*Eubalaena glacialis*) reported to the Right Whale Sighting Advisory System (RWSAS) within Canadian waters in 2015, shown by reporting source. The category “Other” includes reports made by the general public, commercial ships, and fishing vessels. Unconfirmed reports were excluded.



**Figure 4b.** Locations of all right whales (*Eubalaena glacialis*) reported to the Right Whale Sighting Advisory System (RWSAS) within the Northeast region (New York to Maine) in 2015, shown by reporting source. The category “Other” includes reports made by the general public, commercial ships, and fishing vessels. Unconfirmed reports were excluded.

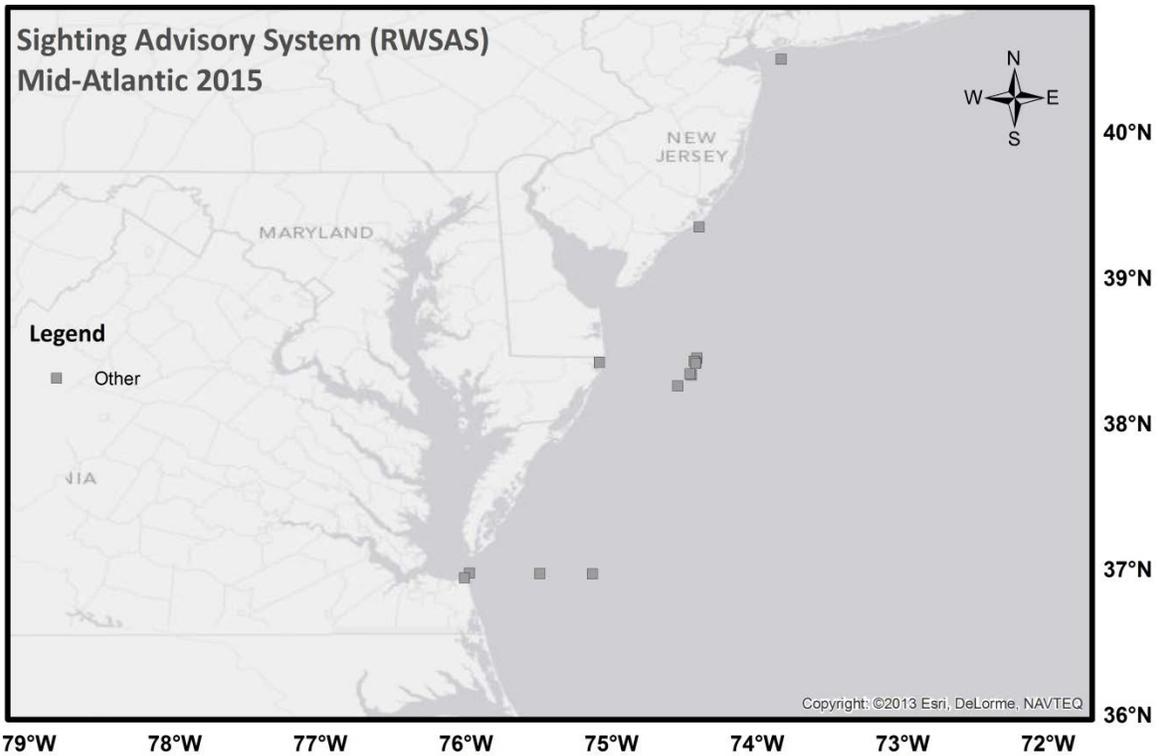


Figure 4c. Locations of all right whale (*Eubalaena glacialis*) sightings reported to the Right Whale Sighting Advisory System (RWSAS) within the Mid-Atlantic region in 2015, shown by reporting source. The category “Other” includes reports made by the general public, commercial ships, and fishing vessels. Unconfirmed reports were excluded.

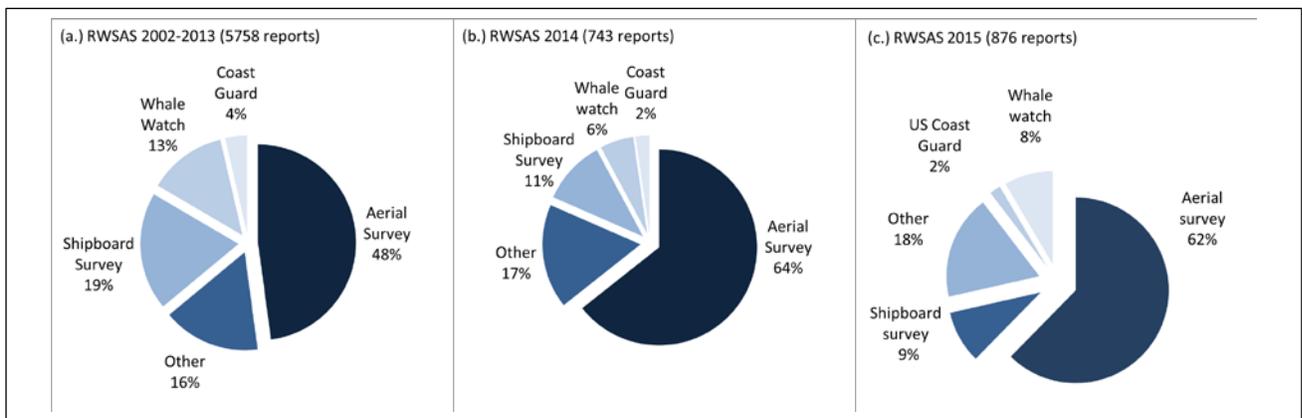


Figure 5. Right Whale Sighting Advisory System (RWSAS) reports by category from (a) all years 2002 – 2013, (b) 2014, and (c) 2015.

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The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

*NOAA Technical Memorandum NMFS-NE* -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

*Northeast Fisheries Science Center Reference Document* -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

*Resource Survey Report* (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

**TO OBTAIN A COPY** of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (<http://www.nefsc.noaa.gov/nefsc/publications/>). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (<http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/>).

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